

# Survey on implementation of EMV across the world

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**Abstract**— EMV is the technical standard that ensures chip-based payment cards and terminals are compatible around the world. The term refers to Euro pay, MasterCard and Visa, the three companies that originally developed the specifications in 1994. Today the EMV standard is managed by EMVCo, LLC, which is equally owned by American Express, JCB, MasterCard and Visa. Detailed information about EMV a chip-based payment transaction occurs when a microprocessor, generally embedded in a plastic card or a personal device such as a mobile phone, connects to an EMV-enabled POS (contact or contactless). The smart chip securely stores information about the payments application and performs cryptographic processing. This provides an additional form of card authentication, validating the legitimacy of the payment type being used.

**Keywords**—EMV, MasterCard, Visa, Data authentication

## I. INTRODUCTION

EMV stands for Europay, MasterCard and Visa, a global standard for inter-operation of integrated circuit cards (IC cards or “chip cards”) and IC card capable point of sale (POS) terminals and automated teller machines (ATMs), for authenticating credit and debit transactions. In a joint effort between Europay, MasterCard and Visa to ensure security and global interoperability so Visa and MasterCard cards can continue to be accepted everywhere. Europay International SA was absorbed into MasterCard in 2002. JCB (formerly Japan Credit Bureau) joined the organization in December 2004 and American Express joined in February 2009. IC card systems based on EMV are being phased in across the world, under names such as “IC Credit” and “Chip and PIN” [9].

Reasons for adopting EMV cards

### A. Physical World Fraud

It is the consensus amongst observers – although there are no published fraud numbers like there are in other domestic markets – which physical world fraud is already above the global average and still on the rise. Furthermore, the lessons learned from the many migration activities worldwide clearly indicate that fraud migrates towards those regions which have not yet migrated to EMV chip technology (Malaysia to Thailand, UK to mainland Europe, etc.) [2]. Since the rest of the world has either already migrated to EMV or has firm

plans to do so, if some country did not move to EMV, it could become the primary target of fraudsters and fraud rates will continue to rise. The move to EMV would, in theory, prevent this from happening.

### B. Cardholder Inconvenience in Abroad

With market penetration of EMV technology deployment growing around the world, in particular the nearly 100% coverage in the Single Euro Payment Area (SEPA). The magnetic stripe technology becomes more and more unsecure [2]. Tens of millions of cardholders have been inconvenienced abroad over the last few years by attendants at POS refusing to take their cards and even more by not being served at unattended terminals.

### C. Mobile and Contactless

Implementing EMV chip technology in the will speed up mobile and contactless payments and make them more secure. The devices that accept EMV chip cards are dual contact/contactless devices. By installing these devices to accept EMV, merchants are also readying themselves to accept mobile and contactless payments as well [2].

### D. Improved Credit Risk Control

Reduce and improve management of bad debt by utilizing chip parameters. E.g. To restrict below floor limits spending. Apply different level of control according to user profile. Provide authentication and platform for id.

### E. Maintain competitiveness

Maintain creditability in customers and competitors eyes. Endorse brand with reliable, secure and innovative products. A migration path for loyalty and multi-application products.

## II. EMV PAYMENT TRANSACTION SECURITY

First, EMV secures the payment transaction with enhanced functionality in three areas [3]:

A. Card authentication, protecting against counterfeit cards. The card is authenticated during the payment transaction, protecting against counterfeit cards. Transactions require an authentic card validated either online by the issuer using a dynamic cryptogram or offline with the terminal using Static Data Authentication (SDA), Dynamic Data Authentication (DDA) or Combined DDA with application cryptogram generation (CDA). EMV transactions also create unique transaction data, so that any captured data cannot be used to execute new transactions.

B. Cardholder verification, authenticating the cardholder and protecting against lost and stolen cards. Cardholder verification ensures that the person attempting to make the transaction is the person to whom the card belongs. EMV supports four cardholder verification methods (CVM): offline PIN, online PIN, signature, or no cardholder verification method (CVM). The issuer prioritizes CVMs based on the associated risk of the transaction (for example, no CVM is

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used for unattended devices where transaction amounts are typically quite low).

C. Transaction authorization, using issuer-defined rules to authorize transactions. The transaction is authorized either online and offline. For an online authorization, transactions proceed as they do today in the U.S. with magnetic stripe cards. The transaction information is sent to the issuer, along with a transaction-specific cryptogram, and the issuer either authorizes or declines the transaction [7].

In an offline EMV transaction, the card and terminal communicate and use issuer-defined risk parameters that are set in the card to determine whether the transaction can be authorized. Offline transactions are used when terminals do not have online connectivity (e.g., at a ticket kiosk) or in countries where telecommunications costs are high.

Third, EMV cards store payment information in a secure chip rather than on a magnetic stripe and the personalization of EMV cards is done using issuer-specific keys. Unlike a magnetic stripe card, it is virtually impossible to create a counterfeit EMV card that can be used to conduct a EMV payment transaction successfully.

### III. BEST PRACTICES FOR IMPLEMENTING EMV-COMPLIANT CARDS

A. Get educated Financial institutions need to learn and understand the complete EMV standard, process and architecture before they can get started. This includes understanding the implementation options and infrastructure requirements needed to rollout such programs [9].

B. Know your options there are various EMV-compliant card programs that can help you get started. This can include pilot programs that do not fully commit to the infrastructure investment of an in-house bureau; central issuance or instant issuance of EMV-compliant cards; or PIN change and PIN selection. And, it can mean determining what is right for you and your cardholders, such as offering contact, contactless or dual-interface cards.

C. Costs Associated. This includes everything from infrastructure changes to cost per card.

D. Understand how NFC personalization technology converges with EMV technology The adoption of a dual-interface chip technology will help prepare the U.S. payment infrastructure for the arrival of NFC-based mobile payments by building the necessary infrastructure to accept and process chip transactions. Understanding the migration to NFC is important to consider when we think about how NFC technology will evolve in the financial and payment landscape.

E. Educating consumers will need to be educated on what EMV-compliant cards are, how they can use them and what the benefits to them include[9]. U.S. consumers are used to using their magnetic stripe cards at payment terminals. With EMV-compliant cards, they will need to be educated on how to insert their card and enter a PIN at each transaction, or 'tap' their card at contactless POS terminals.

### IV. CURRENT STATE OF EMV IMPLEMENTATION IN INDIA

The Reserve Bank of India (RBI) has decided to delay a directive for Indian banks to issue EMV standard cards by June 30. RBI issued the ruling in February 2013 after a surge of credit card fraud in India [4]. The directive stated that all new debit and credit cards are to be enabled with EMV chip and PIN technology, including those issued for international usage. All existing magstripe cards that have been used at least once internationally are also required to be replaced with EMV. Bantwal Bhat, chief information officer at Corporation Bank, commented that Corporation Bank will only issue EMV cards to customers who have used a credit or debit card in a foreign market over the past one or two years. "The cost of issuing a EMV card is five times higher than Master/Visa Card, which has to be borne by the banks," Bhatt concluded. Hon Kuan Lee, regional director of Gemalto, who are helping banks migrate to the EMV standard, said that some Indian banks have started issuing EMV chip cards to customers. The RBI directive also stated that banks are required to put in place more security and risk control measures to make credit and debit card transactions safer. At the end of 2005, Malaysia completed its migration to EMV chip card, with card fraud being reduced by 85% from \$5.9m in 2003 to \$0.3m that year.

### V. EMV IMPLEMENTATION IN VARIOUS COUNTRIES

In many countries of the world, debit card and/or credit card payment networks have implemented liability shifts. Normally, the card issuer is liable for fraudulent transactions. However, after a liability shift is implemented, if the ATM or merchant's point of sale terminal does not support EMV, then the ATM owner or merchant will be liable for the fraudulent transaction [5].

#### A. Africa

- MasterCard's liability shift between countries within this region took place on 1 January 2006. By 1 October 2010, a liability shift had occurred for all point of sale transactions.
- Visa's liability shift for points of sale took place on 1 January 2006. For ATMs, the liability shift took place on 1 January 2008.

#### B. Asia/Pacific Countries

- MasterCard's liability shift between countries within this region took place on 1 January 2006. By 1 October 2010, a liability shift had occurred for all point of sale transactions, except for domestic transactions in China and Japan.
- Visa's liability shift for points of sale took place on 1 October 2010. For ATMs, the liability shift date is 1 October 2015, except in China, India, Japan, and Thailand, where the liability shift will be 1 October 2017. Domestic ATM transactions in China are currently not subject to a liability shift deadline [5].

### C. Europe

- MasterCard's liability shift took place on 1 January 2005.
- Visa's liability shift for points of sale took place on 1 January 2006. For ATMs, the liability shift took place on 1 January 2008.

### D. Latin America and the Caribbean

- MasterCard's liability shift between countries within this region took place on 1 January 2005.
- Visa's liability shift for points of sale took place on 1 October 2012, for any countries in this region that have not already implemented a liability shift. For ATMs, the liability shift will take place on 1 October 2014, for any countries in this region that have not already implemented a liability shift [5].

### E. United States

Visa, MasterCard and Discover in March 2012 - and American Express in June 2012 - have announced their EMV migration plans for the US. In spite of these announcements, doubts remain over the willingness of merchants to develop the capability to support EMV. Since the announcement, multiple banks and card issuers have announced cards with EMV chip-and-signature technology, including American Express, Bank of America, Citibank, JPMorgan Chase, U.S. Bank, and several credit unions. JPMorgan was the first major bank to introduce a card with EMV technology, namely its Palladium card, in mid-2012.

- American Express is implementing a liability shift for point of sale terminals in October, 2015. For pay at the pump, at gas stations, the liability shift is October, 2017.
- Discover is implementing a liability shift on 1 October 2015. For pay at the pump at gas stations, the liability shift is 1 October 2017.
- Maestro is implementing a liability shift of 19 April 2013, for international cards used in the United States.
- MasterCard is implementing a liability shift for point of sale terminals in October, 2015. For pay at the pump, at gas stations, the liability shift is October, 2017. For ATMs, the liability shift date is in October 2016.

## VI. GLOBAL EMV USAGE

EMV is employed today in more than sixty countries and every major economic region of the world except the United States. According to EMVCo, 40 percent of total cards and 70 percent of total terminals deployed outside the U.S. are based on the EMV standard [6].<sup>14</sup> What's more, Visa reports that EMV chip implementation is accelerating globally, with 62 percent of cross-border transactions conducted via a chip card at a chip terminal.<sup>15</sup> The chart in Figure 3 provides an overview of the global adoption by major regions. U.S. data is not included despite there being some cards and some terminals in this market; transactions in the U.S. are not processed as EMV-compliant transactions today [6].

Europe in particular has embraced EMV chip + PIN cards (the use of chip cards and PINs for cardholder verification), largely due to a mandate from the European Payments Council (EPC) as part of the full implementation of the Single Euro Payments Area, SEPA. The EPC has been driving a single rulebook so more than 8,000 banks throughout Europe can process credit and debit payments in a standard fashion.

Region	EMV Cards	Adoption Rate	EMV Terminals	Adoption Rate
Canada, Latin America, and the Caribbean	401M	49.2%	5.6M	78.5%
Asia Pacific	372M	26.7%	5M	50.5%
Africa & the Middle East	50M	28.6%	0.6M	76.7%
Europe Zone 1	755M	80.7%	11.7M	94.5%
Europe Zone 2	46M	15.5%	0.9M	73.2%
United States <sup>1</sup>				
TOTALS	1.62B	44.9%	23.8M	75.7%

\* Figures reported in Q4 2012 and represent the latest statistics from American Express, JCB, MasterCard and Visa, as reported by their member financial institutions globally.  
<sup>1</sup> Figures do not include data from the United States.

Canada, Latin America and The Caribbean	Asia Pacific	Africa and the Middle-East	Europe Zone 1	Europe Zone 2
Canada Mexico All Central American Countries All South American Countries All Caribbean Countries	Australia New Zealand Greater China Japan North & South Korea Mongolia India Sri Lanka Bangladesh Bhutan Nepal South & South-East Asia	All African Countries The Middle East Levant	Andorra Austria Belgium Bulgaria Cyprus Czech Republic Denmark Estonia Finland France Germany Gibraltar Greece Greenland Hungary Iceland Ireland Israel Italy Liechtenstein Latvia Lithuania Luxembourg Malta Netherlands New Caledonia Norway Poland Portugal Romania Slovak Republic Slovenia Spain Sweden Switzerland Turkey UK	Albania Armenia Azerbaijan Belarus Bosnia & Herzegovina Croatia Georgia Kazakhstan Kyrgyzstan Macedonia Moldova Serbia & Montenegro Tajikistan Turkmenistan Russia Ukraine Uzbekistan

\* Data from the United States has not been incorporated into EMVCo's reported statistics. Accordingly, it is not incorporated into the defined regions.

Adoption of the EMV standard in Asia/Pacific has been relatively swift. Government mandates, fraud prevention initiatives and industry competition are driving adoption in Japan, Malaysia, Korea, Indonesia, Taiwan, Australia and many other countries. Even global events shape the market. China's central bank and China Union Pay, the country's domestic card brand, pushed for EMV adoption in the major Chinese cities in order to prepare for the influx of international tourists attending the 2008 Beijing Olympics and the 2010 Shanghai World Expo.

## VII. BENEFITS OF OFFERING EMV-COMPLIANT CARDS

As the payment landscape continues to evolve, financial institutions and card issuers need to begin thinking about what the next steps are for how to offer EMV-compliant cards in their card portfolio to help ensure that they are well positioned in the market as migration happens. Those that do will be in a prime position to differentiate them, acquire new cardholders, and ultimately increase revenue opportunities. If the rate of fraud continues to grow with magnetic stripe cards, consumers will begin to lose confidence in the payment systems. Implementing EMV technology is the best way to protect their customers from fraud. The EMV-compliant card can also provide support for a wide variety of other

applications including secure logon access to bank websites, loyalty programs, identity verification and more. In addition, by offering EMV-compliant cards, Issuers Can:

- Increase Customer Service Levels
- Acquire New Cardholders
- Achieve Top-of-Wallet Status with International Travelers
- Increase International Transaction Market Share
- Increase Interchange Revenue with Global Transactions

It has the following advantages also

No swiping -EMV bankcards contain smart card technology. Smart cards use a computer and software with 100s of built-in security features.

No skimming- Each card has a unique identifier and a digital seal that cannot be copied or cloned and put onto another card; the banks will know that it is a fake, and will refuse authorization.

No online fraud -The card can be used with a device that generates a different one-time-only password each time the card is used online.

Strengthens card-present security -The chip in the card is an active part of the transaction with a reader; the user has card-present security for online banking and payments (previously known as card-not-present).

Interoperable- EMV chip payment cards are already accepted in more than 80 countries.

## VIII. DRAWBACKS

### A. Shifting compliance stances

- There are NO government-enforced mandates for EMV at this time.
- The announcements by MasterCard and Visa are only the first.
- Additional announcements may impact merchants who are early adopters.

### B. Cost

- Almost all merchants in the U.S. will have to make a sizable investment to implement EMV acceptance.
- Merchants will have to balance the hard and soft costs of upgrading systems to support EMV with potential fraud liability costs.

## IX. CONCLUSION

Developing an EMV business case is complex, but all acquirers need to be in the process of developing EMV capabilities. EMV implementation will change the nature of terminal deployment and management as well as customer on-boarding processes moving forward. Acquirers should leverage lessons learned in other markets while also building new tools to manage terminal software updates and reduce operational costs. Do not underestimate the resources that will be needed for EMV migration efforts; establish timelines for implementation and monitor deployment resource constraints. Planning is everything, plan for the future today. The longer an acquirer delays EMV migration, the greater the risk to their business and to their customers.

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